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An Overview on Amazon Rekognition Technology

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AN OVERVIEW ON AMAZON REKOGNITION TECHNOLOGY

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

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in

Information Systems and Technology:

Business Intelligence

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by

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ABSTRACT

The Covid-19 pandemic has disrupted the daily operations of many businesses due to which they were forced to follow the guidelines set by the local, state, and federal government to reduce the spread of the Covid-19 virus. This project focused on how few businesses that resumed their operations during the onset of Covid-19 integrated Amazon Web Services Rekognition technology to comply with government rules and regulations.

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I would like to acknowledge and extend my deepest appreciation for the support provided by Dr. Benjamin Becerra, Dr. Conrad Shayo, and all others who have provided extra encouragement throughout this research project over the past four months.

DEDICATION

This is dedicated to my wife Tejaswi, my daughter Kiara, my parents and other family members and friends. A special acknowledgement to Dr. Benjamin Becerra for the continuous support throughout my Master's program.

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CHAPTER ONE:

INTRODUCTION

Computer Vision Technology

Computer Vision Technology helps computers to understand the content which is in the form of text images, videos and other documents with help of algorithms. (Otte & Otte, 2020)

Starting in the 1960s, the main purpose of Computer Vision Technology was to develop a machine that could visualize like a human being. Later, the intention was transformed into the ability to question computers what they see which led to automating the processes of image recognition and image analysis (Computer Vision Technology, 2020). This resulted in transformation of various manual processes used in Magnetic resonance imaging (MRIs), X-rays, and high-resolution photography.

Vision technology has helped humans in various industries like healthcare, automobile, manufacturing and Forensics (Saxena, 2019). The computer vision technology has improved the safety of the businesses by using advanced video analytics methods like face detection, motion detection, queue management, heat mapping and gesture recognition. This technology has also improved the automotive industry by equipping vehicles with features such as collision detection, parking assistance, driving automation and lane change alerting.

This technology has shown its significance during the pandemic times. It had ensured the safety of a business operations by using advanced analytical methods for the detection of the face mask (USM, 2020), heat mapping to detect a gathering of people, to ensure social distancing measures were being followed, and personal protective equipment (PPE) detection.

Problem Statement

This project will attempt to investigate the importance of recognition technologies for the sustainability of the business. More specifically, how the Amazon Web Services Rekognition technology helped business to sustain during the pandemic.

Research Questions

There are two main questions which this study will answer:

1. How beneficial is having a recognition technology for the sustainability of the business during the Covid-19 pandemic?
2. Can businesses afford any recognition technology?

CHAPTER TWO:

LITERATURE REVIEW

What is Amazon Web Service Rekognition Technology

Amazon Rekognition is a cloud-based computer vision service which was developed by Amazon Web Services in November 2016. Rekognition gives various PC vision capacities, which can be partitioned into two classifications: Algorithms that are pre-prepared on information gathered by Amazon or its accomplices, and calculations that a client can prepare on a custom dataset (Schutz, 2021).

About Amazon Rekognition

Amazon Rekognition enables the user to integrate picture and video analysis to an application using deep learning technology which is very simple to use. With this technology, one can identify people, activities, objects, text, and scenes in images and videos, as well as can identify any inappropriate content (Schutz, 2021). Amazon Rekognition uses its highly authentic facial analysis and facial search capabilities in a variety of instances such as counting people, verification of the users and other public safety uses.

.The custom labels of the Amazon Rekognition helps in screening the images and also identifying the objects which are present in it. A customized model can be built to identify the specific parts, you need to provide some images and scenes and this model will start screening it (Schutz, 2021).

The Amazon Rekognition technology founded by the Amazon scientists which is a deep learning technology which is used to analyze a huge number of videos and images daily (Schutz, 2021). It uses application program interface (API) to perform analysis on any picture or video file which is stored in Amazon S3 (an Amazon cloud storage service). Amazon Rekognition is in continuous development process, as it always adds and improves its new labels by learning from the new data which it has collected.

Amazon Rekognition is Most-Commonly Used in

Videos and image repositories. Amazon Rekognition creates a database of videos and stored images where the user has the capability to search and analyze so one can establish the new trends from the content such as objects and scenes which we find in them (Schutz, 2021).

Verifying the user with their face. Amazon Rekognition integrates an application to affirm user characters by contrasting the current picture in reference to a sample picture (Schutz, 2021).

Safety equipment detection. Amazon Rekognition is also capable of detecting the Personal Protective Equipment (PPE) such as face masks, hand gloves and face shields on the people who are found in the images. It can be

used in places where people are prone for the high risk such as healthcare centers and construction sites (Schutz, 2021) With this we can find out the high risk situations and can send the notifications or warning signals to the people who are working there.

Analyzing the sentiment of the customers. Amazon Rekognition can also capture facial expressions and then analyze them to check whether they are happy, surprised or sad. It then forwards to Amazon Redshift to develop trends like aisle location in the store (Schutz, 2021).

Searching for faces. Amazon Rekognition can also be used for searching for the faces in the images and videos which are stored in the face collection container (Schutz, 2021).

Mature content filter. Amazon Rekognition has the capability to screen the content present in videos and images which are having adult and violent data. With this data, flags are created and labels can be created. These labels can be named based upon the intensity of the content and with these the contents can be managed (Schutz, 2011).

Identifying the celebrities and famous personalities. Amazon Rekognition can also be used for searching for the faces in the images and videos which are stored in the face collection container (Schutz, 2021).

Scanning the text in images. Amazon Rekognition can also be used in detecting the text in images (Schutz, 2021). It identifies the text which is various fonts and sizes and in various orientations. Examples such as identification of the vehicles using the number plates of the vehicles.

Identification of Custom Labels. The Amazon Rekognition Custom Labels helps in identifying the various objects. For example, you can find your products on store aisles by recognizing the logos (Schutz, 2021).

Advantages of Amazon Rekognition

Integration. By integrating Amazon Rekognition and using its API, we can build image and video analysis into any device or applications (Schutz, 2021).

Analysis of videos and images using Deep learning methods. In order to analyze images accurately the Amazon Rekognition uses deep-learning technology for the analysis of images (Schutz, 2021).

Organization and image analysis. Amazon Rekognition can also be used in analyzing the images and can be organized accordingly (Schutz, 2021).

Integrating with other AWS services. Amazon Rekognition is made in such a way that it can be integrated with other AWS services like AWS Lambda and Amazon S3. For example, the images can be saved in Amazon S3 (Schutz, 2021) for further processing and analysis.

Low cost. The pricing of the Amazon Rekognition is very flexible, you pay for the service which you use. There is no minimum or fee commitment (Schutz, 2021).

CHAPTER THREE:

METHODOLOGY

Research

I had used various search engines such as Google Scholar and arxiv.org which is a freely accessible web search engine. Used the keywords such as AWS Rekognition, Rekognition, Rekognition PPE, vision technology and vision. I had limited my search from 2010 to 2021.

Project Demonstration

For the creation of the demo, I had used my laptop which is Dell Inspiron 15 3000 Series a 15.6 Inch Laptop (Intel Core i3 5005U, 8 giga bit (GB) RAM, web camera, 500 GB HDD with Window 10 operating system. I had used the Python IDLE (Python 3.9 64 bit) to run the code including the AWS Rekognition. A person with a mask is introduced, to determine whether the code is detecting the people.

I had used the following python code:

```
import cv2
import boto3
import time
from datetime import datetime
access_key_id = 'AKIARO4CBV44X2DWASWD'
secret_access_key = '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'

#Region
```

```
region='us-east-2'

#client representing AWS Rekognition service
client = boto3.client('rekognition',region, aws_access_key_id = access_key_id,
aws_secret_access_key = secret_access_key)


def processFrame():
    cap = cv2.VideoCapture(0)
    ret, frame = cap.read()
    if ret:
        hasFrame, imageBytes = cv2.imencode(".jpg", frame)
        picname=datetime.now().strftime("%y-%m-%d-%H-%M-%S")
        picname=picname+'.jpg'
        cv2.imwrite(picname,frame)
        if hasFrame:
            session = boto3.session.Session()
            rekognition = session.client('rekognition',region, aws_access_key_id =
access_key_id, aws_secret_access_key = secret_access_key)
            response = rekognition.detect_protective_equipment(
                    Image={'Bytes':imageBytes.tobytes()},
        SummarizationAttributes={
            'MinConfidence': 20,
            'RequiredEquipmentTypes': [
                'FACE_COVER',

            ]
            }
                )
            print(response)
            print(response['Persons'][0]['BodyParts'][0]['Name'])
            if(response['Persons'][0]['BodyParts'][0]['Name']=='FACE'):
                print('face is detected')

print(response['Persons'][0]['BodyParts'][0]['EquipmentDetections'][0]['Type'])

print(response['Persons'][0]['BodyParts'][0]['EquipmentDetections'][0]['Confidence
'])

if(response['Persons'][0]['BodyParts'][0]['EquipmentDetections'][0]['Confidence']>
80):
                    print('mask is detected')
                else:
                    print("mask is not detected")
```

```
        cv2.imshow('frame',frame)
    #cap.release()

frameCaptureThreshold = 300

while (True):
    try:
        processFrame()
        time.sleep(20)
    except Exception as e:
        print("Error: {}.".format(e))
        time.sleep(0.1)

    k = cv2.waitKey(30) & 0xff

    if k == 27:

        break


cap.release()

cv2.destroyAllWindows()
```

CHAPTER FOUR: RESULTS

AWS Rekognition services can be used in various industries such as retail, healthcare and manufacturing. This will allow the businesses to generate customer insights such as the movement of customers inside an establishment, face mask detection and identity recognition. There are few case studies below which shows the implementation of this technology.

Case Study 1: Sanitas

Sanitas, a comprehensive diagnostic network, that offers various imaging services headquartered in Odessa, Ukraine. It uses Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI) clinical scanners to identify a scope of ailments and to helps in improving the wellbeing and prosperity in the neighborhood populace (Sanitas, 2021).

Challenges it Was Facing

As the whole world is facing the coronavirus pandemic in 2020, this showcased a new vulnerability in their healthcare systems (Sanitas, 2021). The local, state and federal authorities enforced the various society guidelines to prevent the transmission of the virus, yet both the government funded and private funded hospitals were occupied by the people who were infected by the COVID-19. The medical practitioners and the hospital staff had to work enduring shifts compromising their safety due to unavailability of the safety equipment.

The country of Ukraine could not escape the rage of COVID-19. There were over 150 thousand COVID cases revealed by the end of August 2020. Even though the Ukrainian authorities pushed to implement wearing of face protection equipment, sanitization policies, physical boundaries between individuals, and shutdown of operations, the circulation of the virus could not be controlled (Sanitas, 2021).

The pandemic had forced businesses to adapt instantly to stop drifting away. So they have come up with various ideas such as providing face coverings, gloves and sanitizers. Some companies have decided to take the help of artificial intelligence (AI) and deep neural learning to protect its consumers and employees. The company had also started to implementing it (Sanitas, 2021).

As the company was having all the infrastructure to perform a Computerized Tomography scan on the lungs of people for detecting the COVID-19, as estimated the outpouring of customers has started. Due to these circumstances the safety of its employees would be under stake. The company has initially decided to monitor through humans whether its employees are using the face mask. As it is unreliable and humans can make some errors, so they were looking for automation (Sanitas, 2021).

Sanitas Approach

Sanitas approached VITech Lab, a certified partner of Amazon Web Services, for its problem. The VITech Lab is involved in providing the customized

solutions for the safety equipment detection for its customers. It wanted VITech Lab to develop a customized solution which detects the violations of the safety equipment such as face masks by its employees and provides the data to its safety team. With this solution they can stop the spread of this virus to its employees and provide its services to the people (Sanitas, 2021).

The VITech Lab group recommended that their personal protective equipment detector for Laboratory Safety could be altered to satisfy the Sanitas' prerequisites. At the center of the identifier is an AI model that measures and breaks down pictures caught by closed-circuit television cameras to point out individuals for not wearing any of four pieces: coveralls, safety glasses, hand gloves and face masks. Warnings are sent when there is a shortfall of PPE is identified (Sanitas, 2021).

To get started, VITech Lab had analyzed the present monitoring solutions and its infrastructure. To achieve the proficient results by this model, the image and motion capturing devices should get the video transfers in superior condition with least dormancy. Assuming this is the case, video transfers can be "cut" outline by casing to push the particular large quality pictures for pixel-by-pixel ML examination. If not, the precision levels in picture acknowledgment would be low and delivering the whole framework pointless (Sanitas, 2021).

At that point, the company’s framework and control system was looked into. Because it was very important for the customer to ensure that another

cloud-facilitated arrangement could be in fact incorporated into the current framework, to limit the expenditure (Sanitas, 2021).

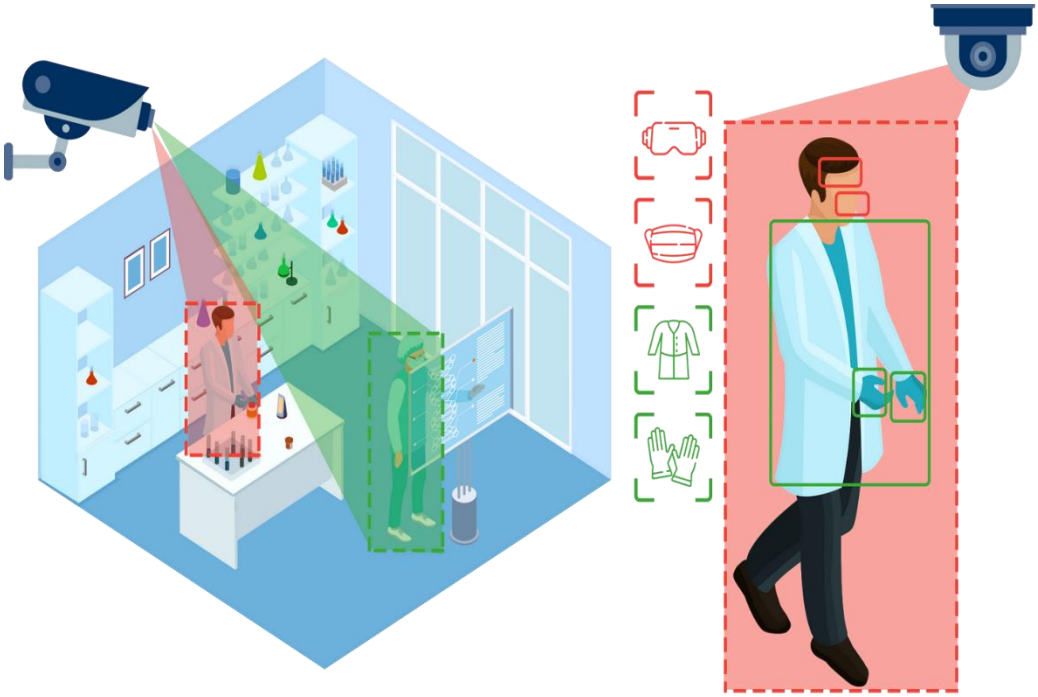

Figure 1. Infrastructure. (Sanitas, 2021)

After all the study has been done a design has been suggested. It consists of three parts: User interface (UI), Application back-end, and Video streams which were processed using machine learning. After the research, Vtech Lab has suggested the following infrastructure (Sanitas, 2021);

- Users access the application's frontend — the user interface — by which they can manage cameras and to receive video streams and violation alerts;
- Using the application, the user signals the backend app and the workers to start creating new video streams; i.e. switch on the cameras;
- The workers start receiving video streams in real time and pushing them to the PPE model;
- The workers push images from video streams to the Amazon SageMaker model endpoint where the PPE violations are detected ;
- Images featuring PPE violations are sent to the backend application to be stored in either Amazon S3 or Amazon RDS;
- The UI gets URLs for every video stream with violations and calls the workers for review;
- Amazon SES is used for user password management and sending reports (Sanitas, 2021)

Results

Since the first AI model utilized in the PPE Detector arrangement was prepared on more than 10,000 pictures of specialists, medical caretakers and patients wearing/not wearing a face veil and different kinds of PPE, the arrangement planned and worked for Sanitas exhibited an efficiency of 97% in the discovery of PPE infringement (Sanitas, 2021).

The arrangement was incorporated with Sanitas' current observing framework, guaranteeing that infringement could be recognized and detailed without a critical interest in another application/UI from the customer.

It can be very well may be handily scaled and executed in new areas as the arrangement is facilitated in the cloud. As it is pay per use, this is very profitable.

High exactness, adaptability, and ease of use of these arrangements permitted Sanitas to screen its premises with high efficiency. Building access territories, regular offices lobbies, and "safe zones" were checked utilizing sharp cameras' people without a face cover were distinguished progressively and promptly answered to the in-house epidemiological group. Thinking proactively and acting promptly were very important in reducing the spread of SARS-CoV-2 (Sanitas, 2021).

As the antibody against COVID-19 was not accessible, the specialists, medical attendants, and people visiting medical services offices remained progressively powerless against the infection. As the customized safety framework was installed, the company guaranteed security of its family community against developing Covid, which permitted the organization to stay afloat and help its neighborhood in the midst of the pandemic (Sanitas, 2021).

Case Study 2: Shopper Sentiment: Analyzing In-Store Customer Experience

Today's Retailers to gain a competitive edge in the market are utilizing video analysis to understand consumer behavior and demography. Each system is designed with a definite task fulfill. For example, a system is designed to track the customers movement through a store, to determine their location history through the aisles of a store and to find the specific products they are interested in (LeBlanc & Dawood, 2018). Second system focuses and holds the store layout, whilst the first record transactions. In the past, if a retailer wanted to utilize data sources for gaining a competitive edge by leading in sales has required a strategy from complex algorithms which also bled the owner of money as it costed a huge investment and a maintenance cost.

This process can be simplified using AWS services to develop a complete in-house solution for video analysis. The analysis is performed using images to overcome a revenue loss, store surveillance cameras are used to capture data to improve the experience of the consumer of the retail store (LeBlanc & Dawood, 2018).

The following diagram showcases the complete structure and utilized Amazon services.

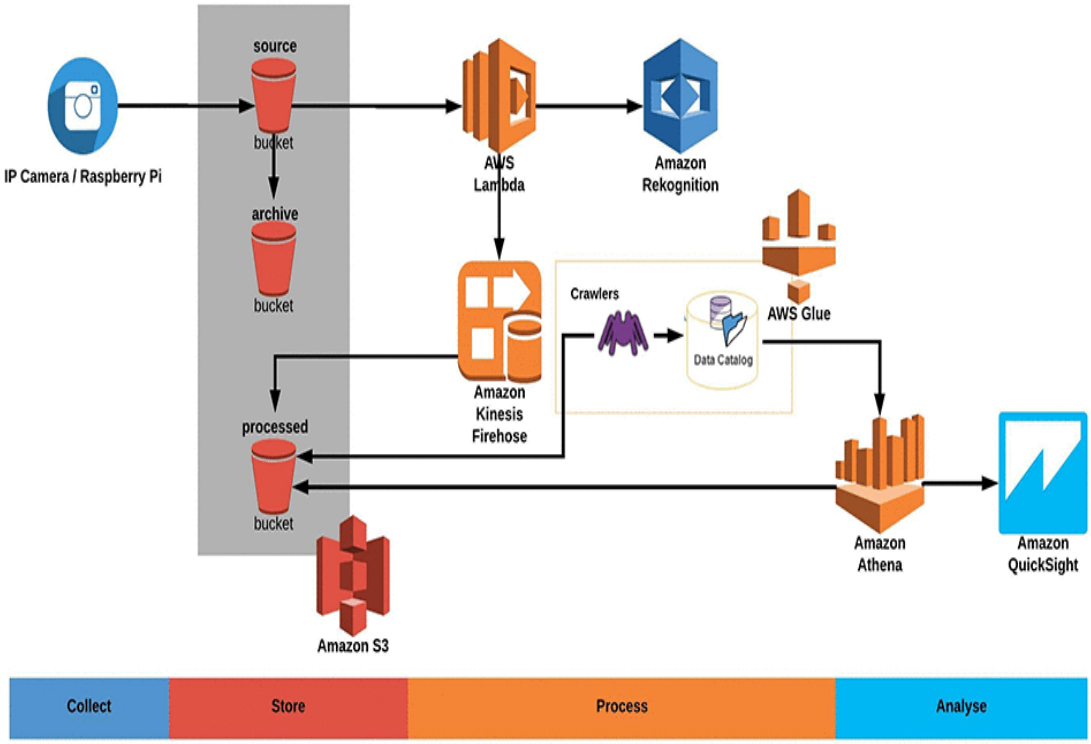

Figure 2. Overall Architecture and AWS Services. (LeBlanc & Dawood, 2018).

Machine Learning services are used on AWS like Amazon Rekognition and using it on images from your store or on motion video, the target is to achieve insights to better understand customer behavior which consists of their movement, demographic separation of store traffic in various indicators like gender and age while generating a pattern of the consumer sentiment. This method is the new normal in this industry, and this particular solution improves the process by making it more accurate, faster, and easier. This kind of analysis can be utilized to generate analysis about the response of a consumer towards

various advertising programs. The response can be viewed in the dashboards which shown below (LeBlanc & Dawood, 2018).

Figure 3. Sentiment Analysis of the customers (LeBlanc & Dawood, 2018).

The Complete solution is consisting of four main steps which are collection, storing, processing and analysis. The description of every component area is as follows:

Collection

First and initial stage aims to collect images or motion videos of consumers inside the store using a camera. This is achieved by using various cameras like an existing closed-circuit television (CCTV) or internet protocol enabled Camera, programmed Raspberry Pi which has an attached camera module, an Amazon Web Servcies DeepLens product (LeBlanc & Dawood, 2018). All the content such as the still images and the video files are stored in Amazon S3 and can be used for the further processing.

For an example, a motion package is installed on a Raspberry Pi. The motion package collects pictures in time of an unusual event that caps the the quantity of data needed to be analyzed (LeBlanc & Dawood, 2018). The package has the capability to identify motion, saves still pictures in a location, and this location is backed up (batch manner or in a real-time) to the input S3 bucket.

Storing

Amazon simple storage service object store is used because it has the benefits such as high approachability, event prompting capabilities and has no limit on the storage. As the bucket has been established, the capability to publish

events to AWS Lambda by Amazon S3 for every new file in the input folder is enabled, then an invoked Lambda function will execute the event data.

Processing

AWS Lambda is used to process the images to analyze the images and then the Amazon Rekognition active product interface is used for generating the required data given by Rekognition for every picture for the facial landmarks which includes the following coordinates in the region of mouth and eye, genders, age category, face coverings like optical aids or masks and the results is sent to an Amazon Kinesis Data Firehose that publishes the data into Simple Storage Service bucket. Amazon Kinesis Data Firehose streamlines the data management because it automates security configuration like encryption, folder structure in regards with time, data compression and optional data transformations.

Outcome of the dataset consists of JavaScript Object Notation files which contains the results from Rekognition representing consumers on these images. To increase efficiency in querying from simple storage service the files should be represented in a columnar-format. It has two options, first is to utilize Amazon Firehose data for the Data Transformation feature, and the next step is to convert the JavaScript Object Notation files using Amazon Glue or Amazon Lambda. Inquiring smaller datasets containing JavaScript Object Notation files is good, but

there would be loss of efficiency if the table expands with in inclusion tens of thousands of files.

Analyzing

The output is placed in a new Amazon simple storage service bucket. As the process follows, the outcome is placed in a JavaScript Object Notation files format which permits to be enquired with Amazon Athena. Hence, AWS Glue Crawlers can be used to gather the data schemas which is on the basis of data stored in S3 and the shared AWS Glue Catalog is used from Amazon Athena to operate on the data. Amazon Athena is a solution which enables the user to operate on the data stored in S3 using SQL commands without any infrastructure disrupting from a spin up. This allows any data visualization tools like Superset, Tableau, or Amazon QuickSight to establish a connection to Athena and also to envision the data. Here, Amazon QuickSight is used to create a dashboard for this data.

Results

The results of image capture events inside a store are displayed in the Quicksight. For example, from the analysis of overall customer sentiment, the user can investigate various aspects such as the customer age range, and the number of people visiting every day from these metrics. After the process of

analysis is completed, the user will be able to share these insights with the organization through a dashboard.

By Utilizing Amazon Rekognition the partitioning of the consumers can be done. One can get evaluation reports on customer experience for a precise location of store.

Case Study 3: Aella Credit

Aella Credit, a company which offers financial services, is a technology startup which provides access to credit for the places where banking establishment is not strong. The company has offices in California, San Francisco; Nigeria, Lagos; and the Philippines. Aella Credit offers risk assessment which is driven by machine learning in both Business-to-business combining with employers as well as cooperatives and a Business to consumer model to decide whether that person is eligible for a loan (Aella Credit, 2018).

The Major Challenges Faced by Aella Credit

Looking for cloud support. Aella Credit is engaged in providing instant loans to the people who are residing in Africa through a mobile application as their platform. It understood that it does not have required technology support. “We launched the company in the cloud, but the technology we used was holding us back,” as quoted by the company's Chief Technology Officer. “It didn’t offer us the innovative features we needed.” Consider an instance, the organization require superior path to establish employees' identities and Federally designated

identifications in real time, beyond any manual verification. In the country Nigeria, there is no option for an active product interface to be used to identify government identities in real time. This led a tedious process of verification to the company and which led to duplicate datasets and multiple user profiles (Aella Credit, 2018).

In order to solve this problem, company needs to make sure that it would find a technology which supports its loan-processing software. “We can’t afford to have any downtime, because we’re dealing with our customers’ money,” according to the CTO (Aella Credit, 2018).

Why did Aella Credit Decided to Go With AWS

The company has chosen AWS as their supplier. “AWS met our needs perfectly in terms of innovative features and scalability,” according to company’s Chief Technology Officer. Aella Credit uses Amazon Elastic Compute Cloud (Amazon EC2) cases for its online loan- processing solution and also the Amazon RDS for My Structure Query Language for assistance. “Support for My Structure Query Language was one of the key reasons we decided on AWS,” according to the company's Chief Technology Officer.

Aella Credit has chosen Amazon’s Rekognition for facial detection for new customers. So if any customer uploads a profile picture to their mobile application, the image would be received by Amazon Rekognition and it would be

saved to Amazon S3, data repository. Then consumer's facial expression is also analyzed, saved in the Amazon Relational Database Service.

When a consumer updates their display photos, then the updated display picture is then forwarded to Amazon Rekognition for identification. If the identical matches are found, the consumer can modify the pictures if there is no match, the pictures cannot be changed (Aella Credit, 2018). If a consumer applies for credit the Amazon Rekognition validates federal designated identities to a sample pictures. At any given time the consumers or employees upload their Identification, it is compared and contrasted with other sample identifications. When the picture matches the display picture, only then consumers are granted credit.

Identity Verification Challenges

By using the Amazon Rekognition, it is innovating by using Amazon's innovative technologies, which led the company to solve its identity verification challenges. Using Amazon Rekognition, the company upgraded its efficiency in face verification process by greater than forty percentage. "This technology is very good at identifying customers based on their eye color or facial expressions, and we are using data analysis to recognize patterns that can help us better protect customers and their data," as Chief Technology Officer stated. "Identity verification is a major problem for financial services companies in Nigeria, and

we can overcome that challenge by using Amazon Rekognition. That gives us a competitive edge as a startup.” As a result of the upgraded identity verification, the company grew at a rapid pace because consumers had high confidence in the security capabilities of the bank (Aella Credit, 2018).

Benefits

On the Assurance of no outages as many consumers have joined in a very short period of time.

The company assures huge opportunity for its credit-processing software and consumer repositories. “We have had zero instances of system downtime since we moved to AWS and started using MySQL on Amazon RDS,” as stated by Chief Technology Officer. “AWS is incredibly reliable, so that gives us more time to focus on innovation rather than managing infrastructure.”

Aella Credit is on a path of exponential growth since the utilization of AWS, it has led the expansion from Nigeria to various markets of the world. “We went from 5,000 customers to 200,000 customers in just a few months because AWS helps us scale very quickly,” as stated by the company. “And even if we scale to a million customers at some point, we won’t have to worry about managing our architecture ourselves. We can just focus on developing new features to further differentiate our business. (Aella Credit, 2018).”

Results

By using the AWS services, the company improved its facial recognition accuracy by 40%, its software has grown globally and the customer base has been grown from 5,000 to 200,000.

Market Share of Cloud Services Providers

The below graph describes the market share of the cloud providers for the years 2017, 2018, 2019 and 2020 (Miller, 2021).

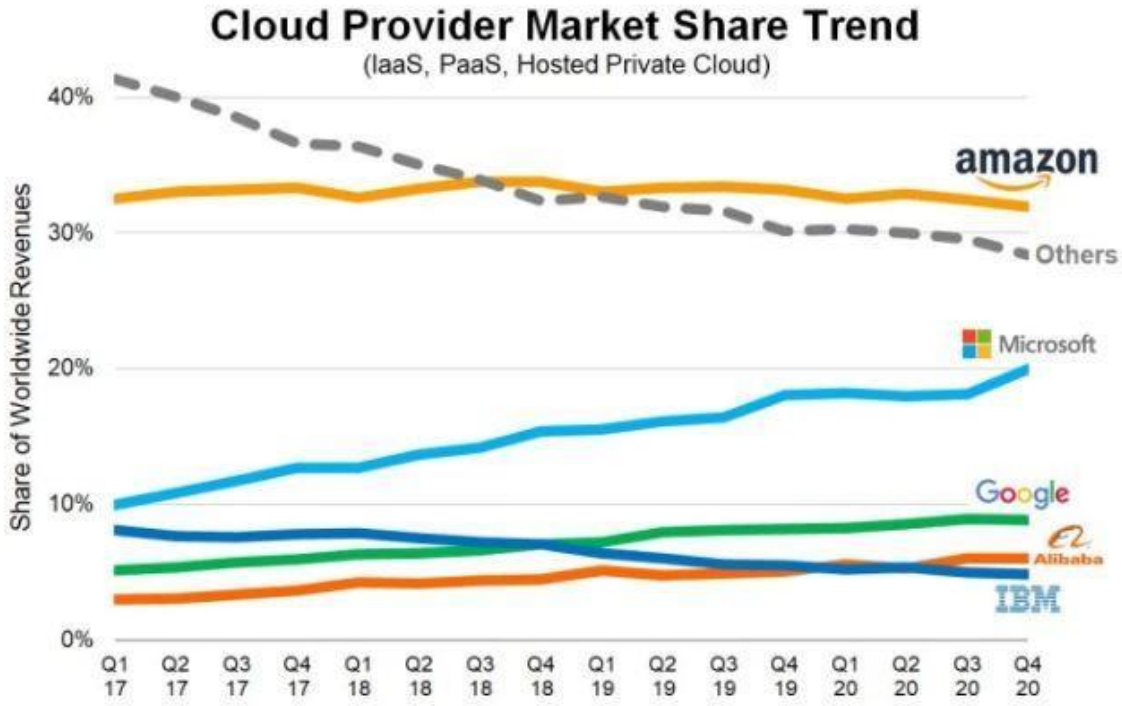

Figure 4. Market Share. (Miller, 2021)

CHAPTER FIVE:

DISCUSSIONS AND RECOMMENDATIONS

Overview

The purpose of this study is to explore about the usage of the AWS Rekognition technology to increase the revenue of the small businesses.

In the first case study Sanitas, the results indicate that it has been 97% effective in detecting the PPE violations. Here the solution was implemented on the existing infrastructure of the Sanitas, so there was not any expenditure incurred for the infrastructure. So, the companies which do not have required infrastructure then the budget would take a rise. As most of the small business would not be having much of the infrastructure such as the cameras which are used for capturing the videos and images.

In the second case study, the shopper sentiment has been analyzed by building a solution with various services of Amazon such as AWS Glue, Amazon S3, Amazon Rekognition, AWS Athena, AWS Lambda, and AWS QuickSight. By using all the services and applied them to motion video and images from a store and had measured the customer reactions to the brand content, signage and end cap displays. For the future, with the help of the Kinesis Videostreams, the existing videos the customers' shopping path can be captured.

In the third case study, Aella Credit has used Amazon Elastic Compute Cloud (Amazon EC2), Amazon Relational Database Service for MySQL (Amazon RDS for MySQL) and Amazon Rekognition to process its loan. With the Amazon

Rekognition, the company's face verification accuracy has increased by 40%. There is enough room for development and increase the accuracy to 80%. It can also be used by law enforcement officials for identifying the criminals.

Limitations

There were several limitations in this study. The main focus was on AWS Rekognition technology, and did not explore other similar platforms such as Microsoft Azure Computer Vision, Google Cloud Vision API and IBM Watson.

Future Directions

In light of these limitations, there were several notable areas brought up in this research the AWS Rekognition technology serves in various industries from retail to medical. This technology could be used in various autonomous vehicles, robotic vision, detection of age, detecting unsafe content in user generated content, detecting gender, and law enforcement.

REFERENCES

LeBlanc, B., & Dawood, I. (2018). Blogs. Retrieved April 10, 2021, from https://aws.amazon.com/blogs/machine-learning/shopper-sentiment-analyzing-in-store-customer-experience/

Mihajlovic, I. (2020, February 09). Everything you ever wanted to know about computer VISION. Here's a look why it's so awesome. Retrieved April 17, 2021, from https://towardsdatascience.com/everything-you-ever-wanted-to-know-about-computer-vision-heres-a-look-why-it-s-so-awesome-e8a58dfb641e

Miller, R. (2021, February 04). The cloud infrastructure market hit $129B in 2020. Retrieved from https://techcrunch.com/2021/02/04/the-cloud-infrastructure-market-hit-129b-in-2020/

Otte, S., & Otte, S. (2020, January 30). Understanding the computer vision technology. Retrieved April 09, 2021, from https://www.innoplexus.com/blog/understanding-the-computer-vision-technology/#:~:text=Computer%20vision%20is%20an%20AI,images%2C%20PDFs%2C%20videos%20etc.&text=Its%20uses%20and%20purposes%20range,motion%20estimation%20to%20many%20more.

Saxena, A. (2019, December 10). Exploring the potential of computer vision across industries. Retrieved April 17, 2021, from https://www.einfochips.com/blog/exploring-the-potential-of-computer-vision-across-industries/

Schütz, J. (2021). Amazon Rekognition resources. Retrieved April 18, 2021, from https://aws.amazon.com/rekognition/resources/?nc=sn

Sanitas: Face Mask Detection in Medical Facilities. (n.d.). Retrieved April 10, 2021, from https://vitechlab.com/case-study-sanitas

Understanding the Computer Vision Technology. (n.d.). Retrieved April 10, 2021, from https://medium.com/@Innoplexus/understanding-the-computer-vision-technology-cf4d4fa9045c

U., & Says:, Z. (n.d.). Computer vision applications in different industries. Retrieved April 17, 2021, from https://usmsystems.com/computer-vision-applications/

What is computer Vision Technology? (2020, December 04). Retrieved April 09, 2021, from https://discover.bot/bot-talk/computer-vision-technology/